Findings and Outcomes
Probabilistic Forecasting Workshop
22-24 October 2008
Boulder, Colorado

Forecasters representing Western Region, Central Region, Eastern Region, and Southern Region met with GSD software developers to philosophize about probabilistic weather forecasting in the context of National Weather Service field offices today and in the future, and to examine and critique prototype workstation capabilities designed by GSD staff to enable production of probabilistic forecasts. Participants from NWS national offices provided context, research perspectives, and planning guidance. Our goal was to initiate the process of determining how forecasters can best add value to guidance on probabilistic forecasts. We asked, what AWIPS II capabilities are required to enable forecasters? In other words, we're trying to figure out the forecast process.

Revised Strawman Forecast Process. After being introduced to the GSD prototype tools and strawman forecast process, lively discussions and feedback led the forecasters to a revised process. The revised concept is to incrementally modify current practices for producing deterministic forecast products (i.e., those currently posted to NDFD), by providing options to invoke any of several types of statistical techniques and/or guidance to help the forecasters wrap uncertainty components around the official forecast in an efficient manner that leaves room for forecaster input or quality control. This implies that the current NDFD product, temperature for example, is to be interpreted as the median of the forecast PDF.

The probability distribution function for each weather element can be generated through a variety of possible methods. A popular example is Steve Amburn's method for estimating the probability of QPF in excess of multiple thresholds (PQPF) based completely on the two precipitation products (PoP and QPF) already being produced. (Steve's powerpoint is available for download from the workshop web site.) Krzysztofowicz and Evans (W&F 2008, also available from the web site) offers a potential option for estimating temperature forecast uncertainty directly from NDFD forecasts. This method incorporates statistical information from the joint distribution of historical forecasts and observations. Centrally-produced guidance based on MDL's EKDMOS, or NCEP's NAEFS downscaling, or NCEP's reforecast-based products could also be used to generate uncertainty information. In this case, the forecasters may add value by weighting ensemble members, or by simply adjusting the modeled PDF around the official forecast or possibly other techniques yet to be explored.

Some relevant issues were raised and recognized as important topics for further consideration:

- The appropriateness of representing forecast PDFs as a small number of points (e.g., 10/50/90) on a pre-selected basis function (perhaps Gaussian for temperature), as opposed to a histogram representation (i.e., no basis function required), which is simpler but larger.
- The practical aspects of graphically editing PDFs and propagating those

changes appropriately in space and time.
- The necessary and appropriate ensemble model information required to optimize forecaster performance, and the potential role of local models.

Feedback and Redevelopment. Much more exploratory work is needed to test the evolving forecast process and continue figuring out how to forecast uncertainty. The challenge is to develop scientifically validated capabilities that allow forecasters to effectively intervene in the forecast process in a consistent way across space, time and meteorological parameters and to produce uncertainty forecast products that are reliable and meaningful. To this end, workshop participants endorsed providing them with a suite of prototype capabilities so that they may interact with developers in an iterative process. This involves installing prototype systems in a small number of forecast offices; forecasters can point out problems and request capabilities, and developers will respond with software fixes and new solutions. Forecast offices can set up the software on experimental machines separate from operations. This will enable them to experiment with the ensemble data visualization tools and explore multiple ways of generating probabilistic forecasts. Feedback and communication are to be facilitated using an online forum with email notification.

Given the proximity of the BOU forecast office to the GSD facility, and the success of similar interactions in the past, this is the first logical place to stage the experimental software, with the intention to expand the experiment to other offices. The offices represented in the workshop each volunteered to be part of this experiment. We would also like to identify one of the National Centers as a primary cooperator as soon as possible.

We intend to coordinate with the other stakeholders in this effort, including:
- Doug Hilderbrand and the five NFUSE subgroups
- SSD chiefs
- Scott Jacobs, representing NAWIPS and the National Centers
- WAS*IS and others representing customer needs
- AWIPS II developers and planners to ensure that gaps are addressed

Once the process has begun, we can expand the scope to include NSSL's gridded warning capabilities and AOML's hurricane-related techniques.

Consideration of customer needs. Organizers of the workshop sought answers to the questions, "What does the forecaster need to know about customer needs?"

We offered two positions for discussion. 1 – Nothing at all: the forecaster should be focused on science, not on impacts, and the science should not be compromised. 2 – Forecasters need to know what decisions are being supported in order to bring the best possible science to the solution; many products were developed by addressing customer needs.

Forecaster consensus was that when creating the forecast, science should not be compromised, but in practice, forecasters can and do wear two hats, acting both as

scientists to produce the forecast, and interpreters to aid decisions makers. Hedging can and will happen but it is not seen as a significant threat to NWS service quality.

When acting as scientists, forecasters ask "What is the meteorological problem?" When acting as interpretors, they ask "What are the impacts? What are the opportunities for decision assistance? What are the resources that we need?" To answer these questions, it is important to have two-way communication between the forecaster and customers, and it was suggested that social scientists could play an important role in this communication.

Lastly, it was also discussed that in order to achieve a successful incorporation of probabilistic forecast into NWS operations not only the forecast process and techniques need revision, which was the main purpose of this workshop, but also a parallel effort has to be set in place and overseen by the NFUSE program to address the question of how WFO forecast and warning products and services will be enhanced/modified/changed to effectively incorporate this new kind of forecast data. This is critical to the success of this vision of the future.

Participants

Doug Hilderbrand, OST
Steve Schotz, OST
Scott Jacobs, NCO
Matt Peroutka, OST/MDL
Pablo Santos, WFO Miami
Steve Amburn, WFO Tulsa
Rich Grumm, WFO State College
Larry Dunn, WFO Salt Lake
Dave Metze, WFO Pueblo
Michael Hudson, NWS CR
Andrea Schumacher, CIRA

GSD:

Paul Schultz, Project Manager
Tom LeFebvre, GFE
Tracy Hansen, GFE
Jim Ramer, D2D
Ashvin Mysore, advanced graphics
Leigh Cheatwood-Harris, research and web services

Lectures:

Tom Hamill, ESRL/PSD
Zoltan Toth, NCEP
David Novak, ER